EPICS at Fermilab: Not just D0 anymore - Cavities, Cavities, Cavities

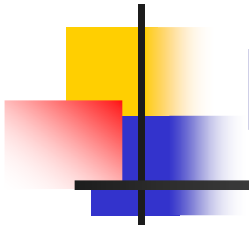
Geoff Savage for the Dzero and ILCTA controls groups

Wed June 14, 2006

EPICS Collaboration Meeting

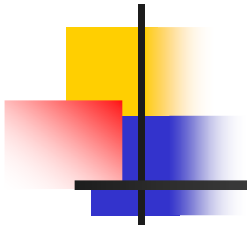
Current EPICS Projects

- Run II Experiments
  - D0 Controls.
- ILC Test Accelerator (ILCTA) @ FNAL
  - Cavity testing in three facilities, maybe a fourth
  - Horizontal Test Facility/Coupler conditioning (MDB)
    - Run tests in August 2006
  - Vertical Test Facility (IB1)
    - Getting started
  - Beam test (NML) using photoinjector currently at A0
    - Preparing facility - cryo installed at the end of 2007
- Other
  - Proton Driver – EPICS only control system
  - Nova – Seriously evaluating EPICS as control system for DAQ. Maybe also for controls itself?



D0 Detector

- Increased luminosity in Run IIb
- Just finished detector upgrade
  - Silicon layer 0
  - Enhanced triggering systems
- Goals for controls
  - Support new field busses
  - Remove 68k processors from system
  - Move to EPICS 3.14.8.2
- Controls - all EPICS all the time
  - DAQ controls are independent



D0 Controls

- Two new field buses
  - CANbus driver wrapped in ASYN
    - TPMC816 - dual channel PMC CANbus module
    - Implements limited CANbus feature set
  - Raw ethernet driver in ASYN
    - Linux IOC connected via fiber to remote crate
- Trying to get to 3.14.8.2
  - Tested but not deployed
  - Currently using 3.14.6 and 3.13.4
- MVME5500 processors
  - Remove remaining 68k processors ~ 25
  - Some problems - similar experiences?

ILCTA Controls Systems

- ACNET (FNAL)
  - Accelerator Division
  - Drivers/interfaces for FNAL devices already written and in use at Fermilab in ILCTA (HRM)
- EPICS (ANL)
  - Cryogenics interface for MDB and NML.
  - Maybe for IB1, but have large IFIX base.
  - IB1 controls system
  - At least partial (maybe complete) control system at MDB
- DOOCS (DESY)
  - LLRF (Simcon 2.1/3.1 boards) supplied by DESY
    - EPICS driver written, being debugged
  - Digitizers supplied by DESY
  - A0 is dominated by DOOCS devices.
  - Photoinjector will move to NML being controlled by DOOCS

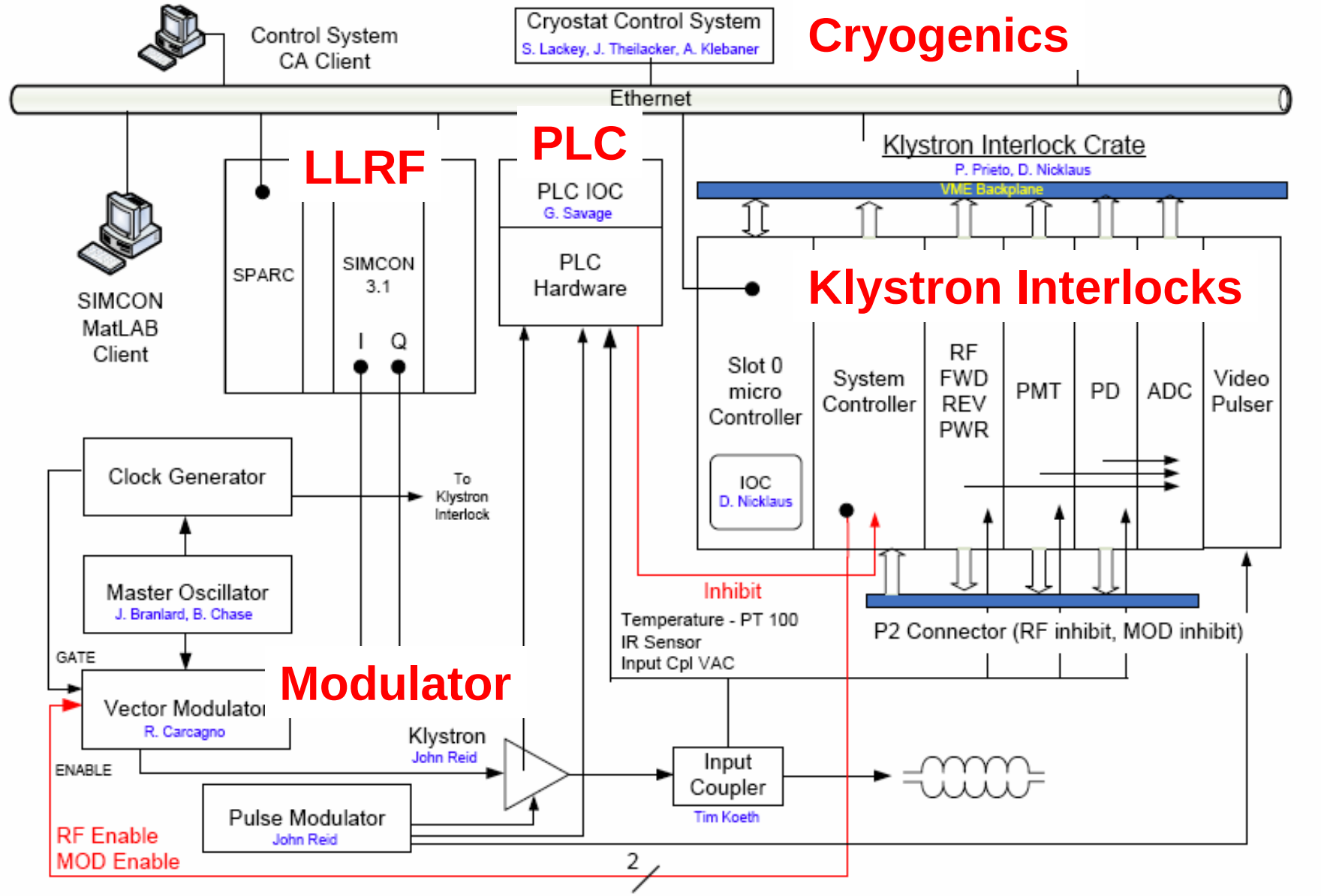
Which Control System? and then Some

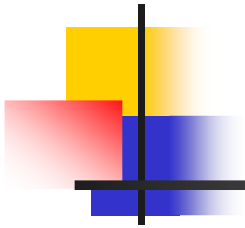
- ILCTA review committee in FY05 recommended picking one
  - all were considered considered capable of meeting technical requirements
  - Recommended DOOCS or EPICS with a slight preference for EPICS because more technical help available
  - Have not yet achieved this (LLRF controller is DOOCS)
- IFIX (Intellution) / APACS - Cryo
- Matlab and LabView
  - Engineering development tools, not control systems
  - Try to limit usage to analysis

FNAL EPICS Personnel

- About 10 people from all over the lab – most are new to EPICS < 6 months experience.
- Accelerator division
  - Sharon Lackey, Dennis Nicklaus, Paul Joireman, Kevin Martin
- Technical division
  - Dennis Shpakov
- Particle physics division
  - Vladimir Sirotenkov, Fritz Bartlett, Geoff Savage
- Computing division
  - Ron Rechenmacher (DOOCS), Luciano Piccoli (DOOCS), Kurt Biery (Nova)

ILCTA MDB - Paul Joireman



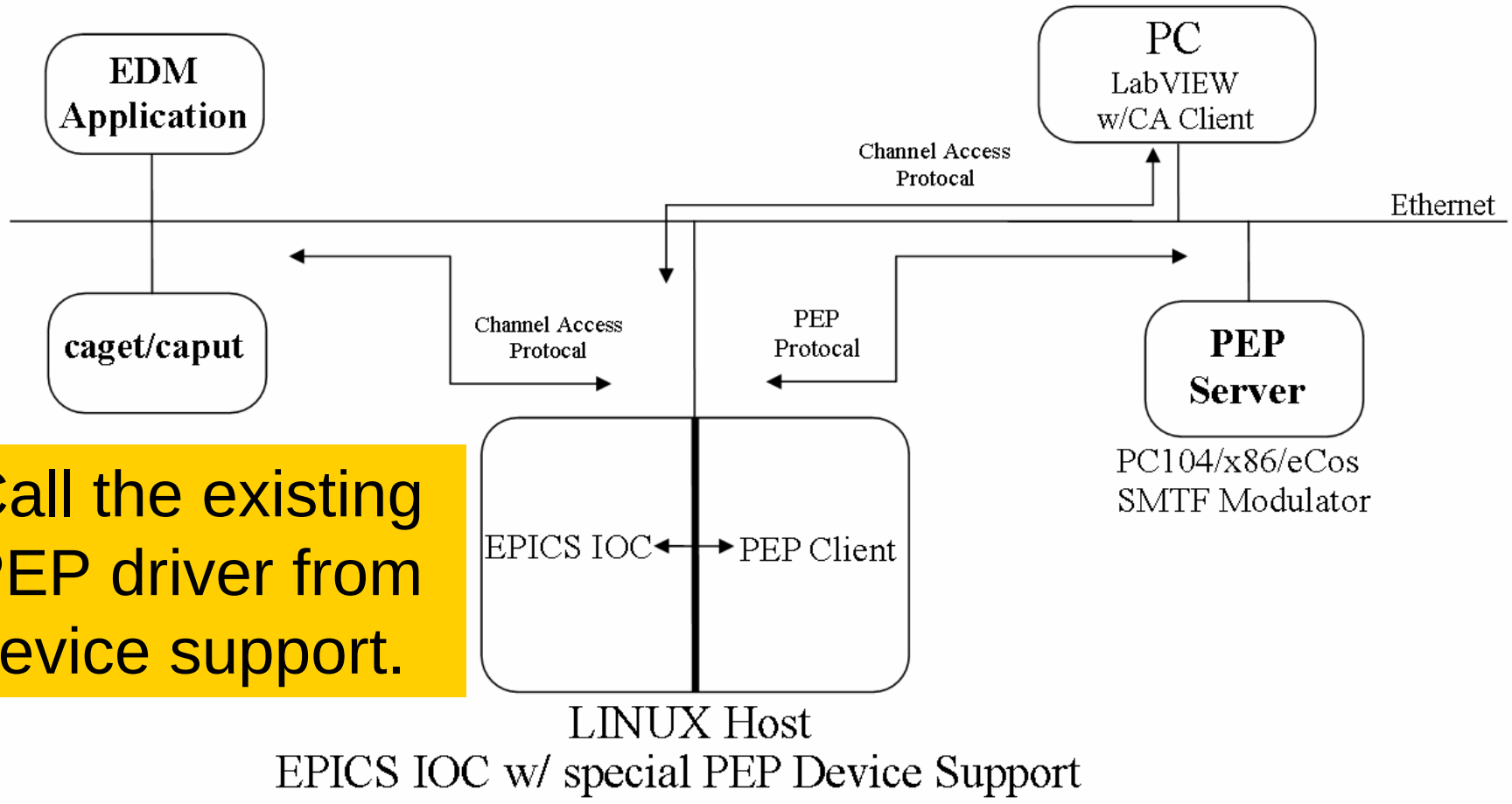


EPICS Pieces

- Tools
  - EDM
  - Channel archiver
  - Sequencer
  - Java CA
- vxWorks IOC
  - vxWorks VME device support
  - vxWorks symbolic device support
  - User written C/C++
- Linux IOC
  - Driver called from device support
  - Commercial driver wrapped in ASYN
- Windows IOC
  - OPC device support from BESSY

Modulator Control

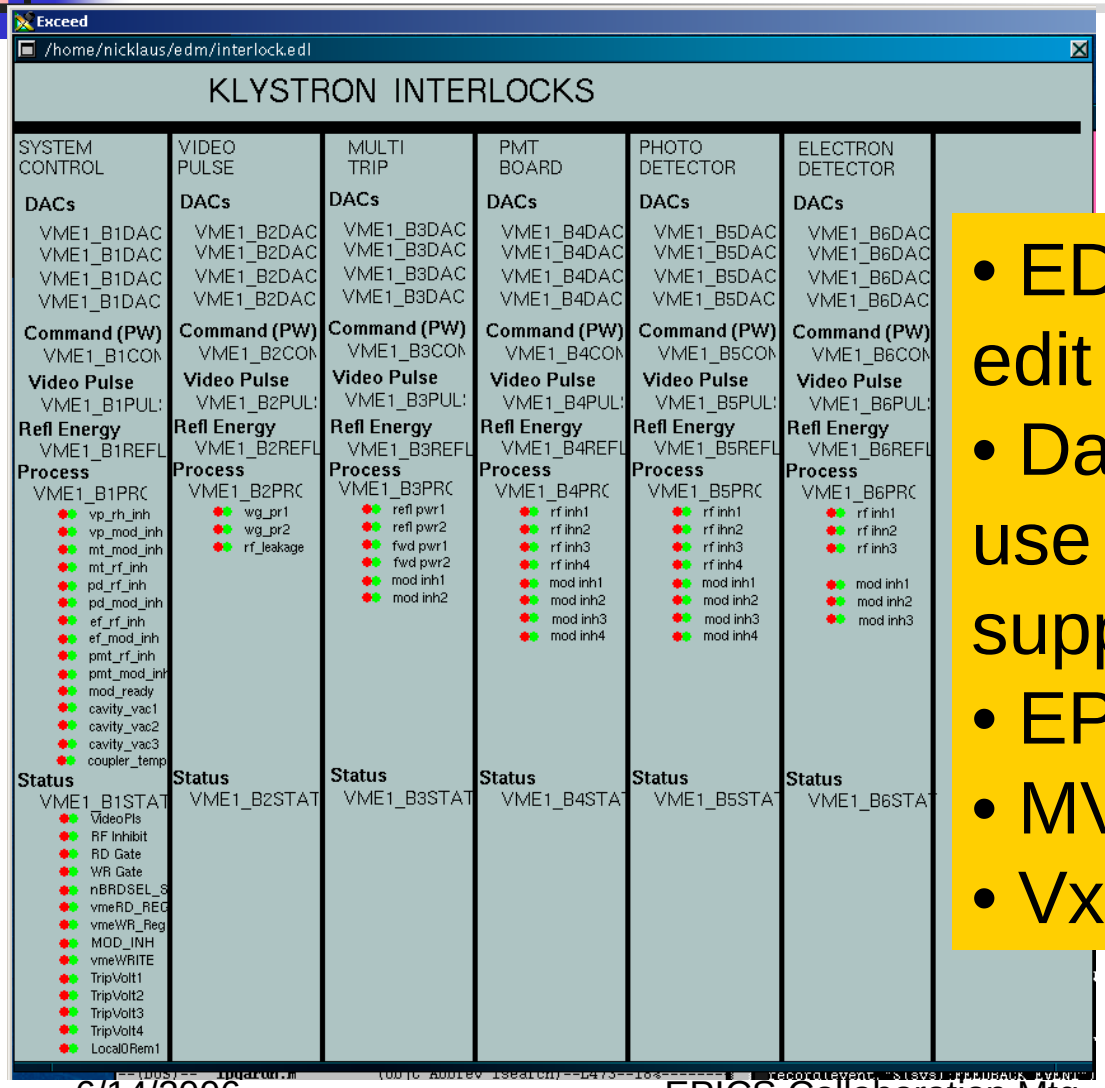
Kevin Martin



Call the existing PEP driver from device support.

Klystron Interlocks

Dennis Nicklaus



- EDM screen shot - edit mode
- Database records use VME device support from vxWorks
- EPICS R3.14.7
- MVME2434
- VxWorks 5.4

ADC Readout

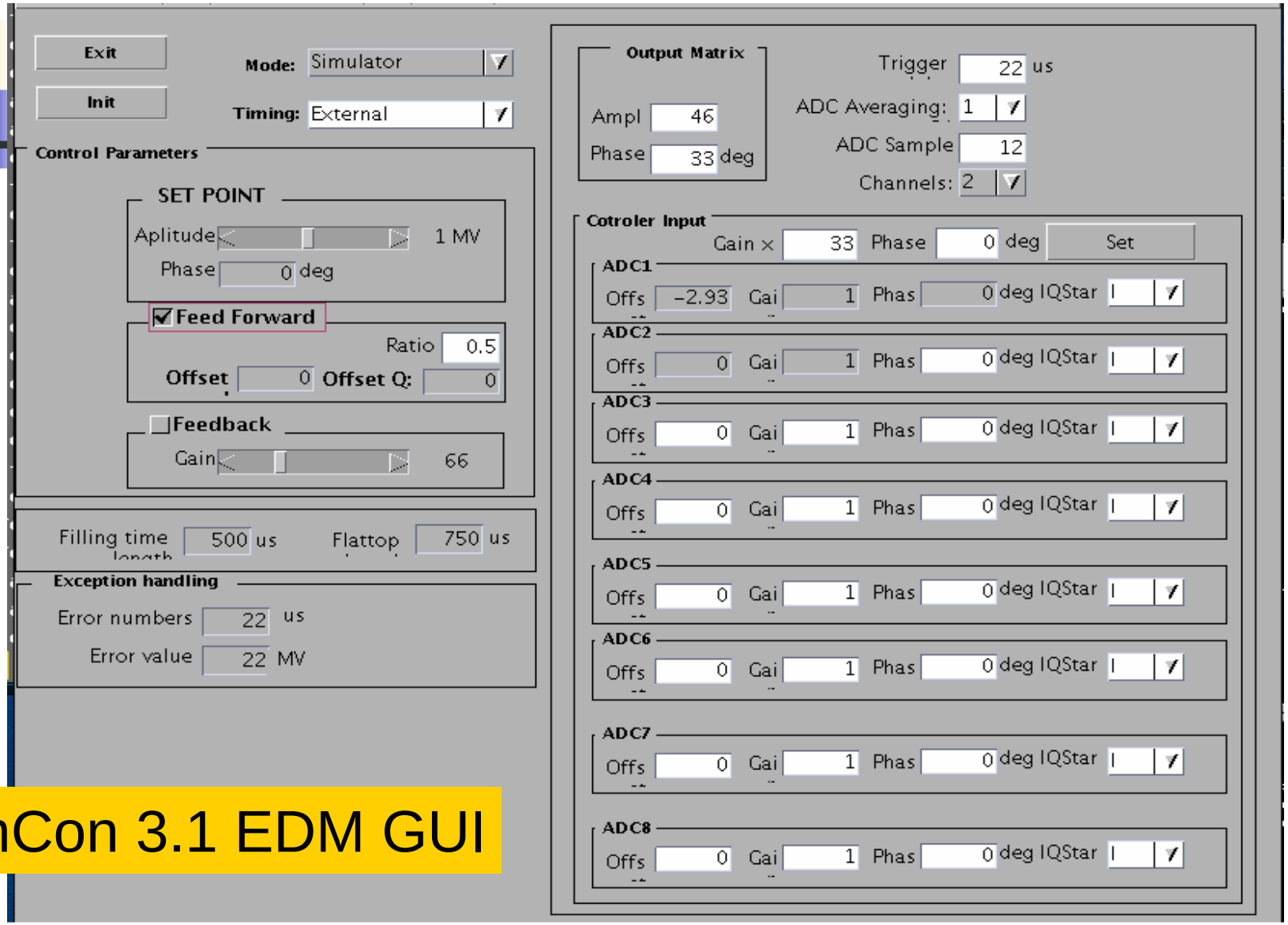
Paul Joireman

- For klystron interlocks
- 12 channel 16-bit VME module
- EPICS R3.14.7, vxWorks 5.4, MVME 2434
- Control/monitor with vme device support
- Data readout into processor memory and initialization with C++ driver
- Access data with EPICS vxWorks symbolic device support

LLRF - Accelerator Division

Dennis Nicklaus and Sharon Lackey

- SimCon 3.1
  - From DESY with DOOCS driver
  - Controlled from Force processor
  - Matlab interface - abandoned
- Database records use vxWorks VME device support
- EPICS R3.14.7, VxWorks 5.4, MVME2434
- Create user interface with EPICS Display Manager (EDM)



SimCon 3.1 EDM GUI

LLRF - Technical Division

Dennis Shpakov

- Learn how the SimCon 3.1 card works
- Use C functions to perform initialization
- Control/Monitor with VME device support
- EPICS R3.14.8.2, MVME5500, vxWorks 6.1

PLC Communication

Geoff Savage

- AutomationDirect DirectLogic PLCs
  - Use for general purpose I/O and PLC logic
- Implement network communication through add-on ECOM module
  - DirectNET over ethernet protocol
  - Serial communication requires more infrastructure
- Wrap the supplied linux driver in the ASYN framework
- Use ASYN device support - devEpics
- Linux desktop, EPICS R3.14.8.2

Conditioning Control

Dennis Nicklaus

- Use the sequencer to control the cavity conditioning sequence
- Requires all the systems to be accessible via EPICS
- EPICS is a “glue” that connects systems from different groups

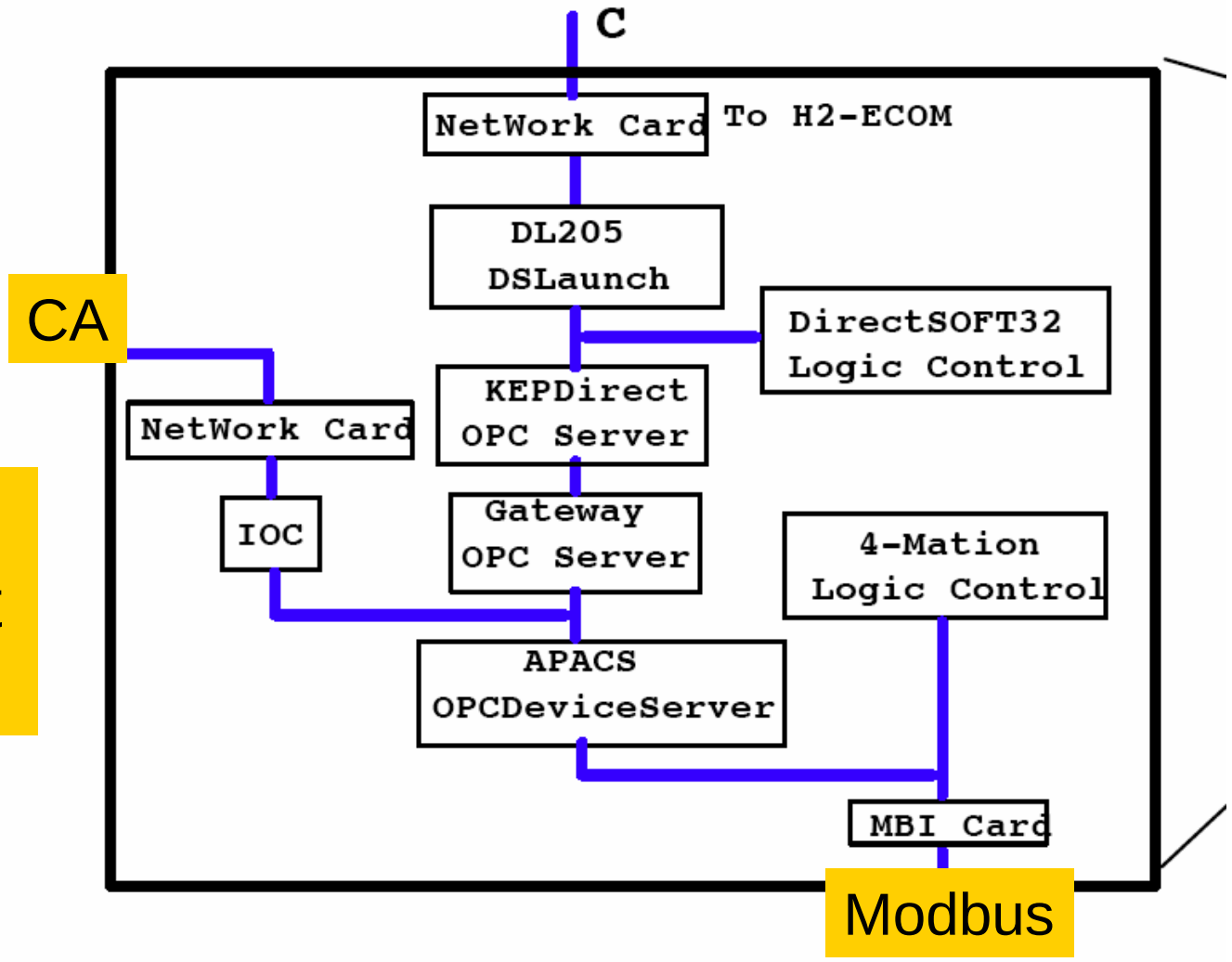
Gateways to Other Systems

- EPICS IOC that would be a gateway to DOOCS - Ron Rechenmacher
  - DOOCS is already a CA client (R3.12?)
- ACNET-EPICS - Vladimir Sirotenko
- IFIX-EPICS - Vladimir Sirotenko at D0
- IFIX/APACS-EPICS through OPC - Vladimir Sirotenko
- Labview - EPICS community

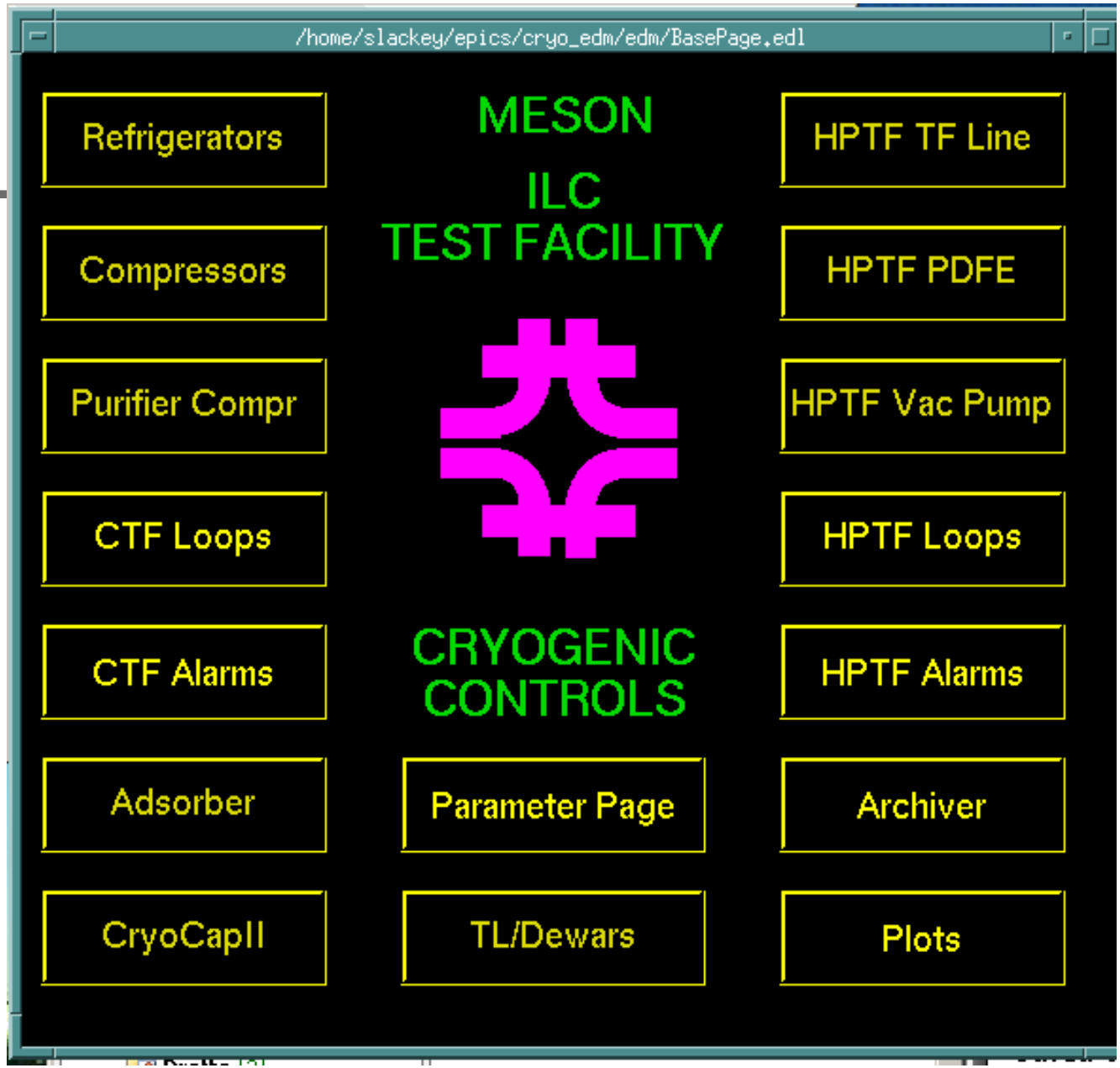
Cryogenic Systems

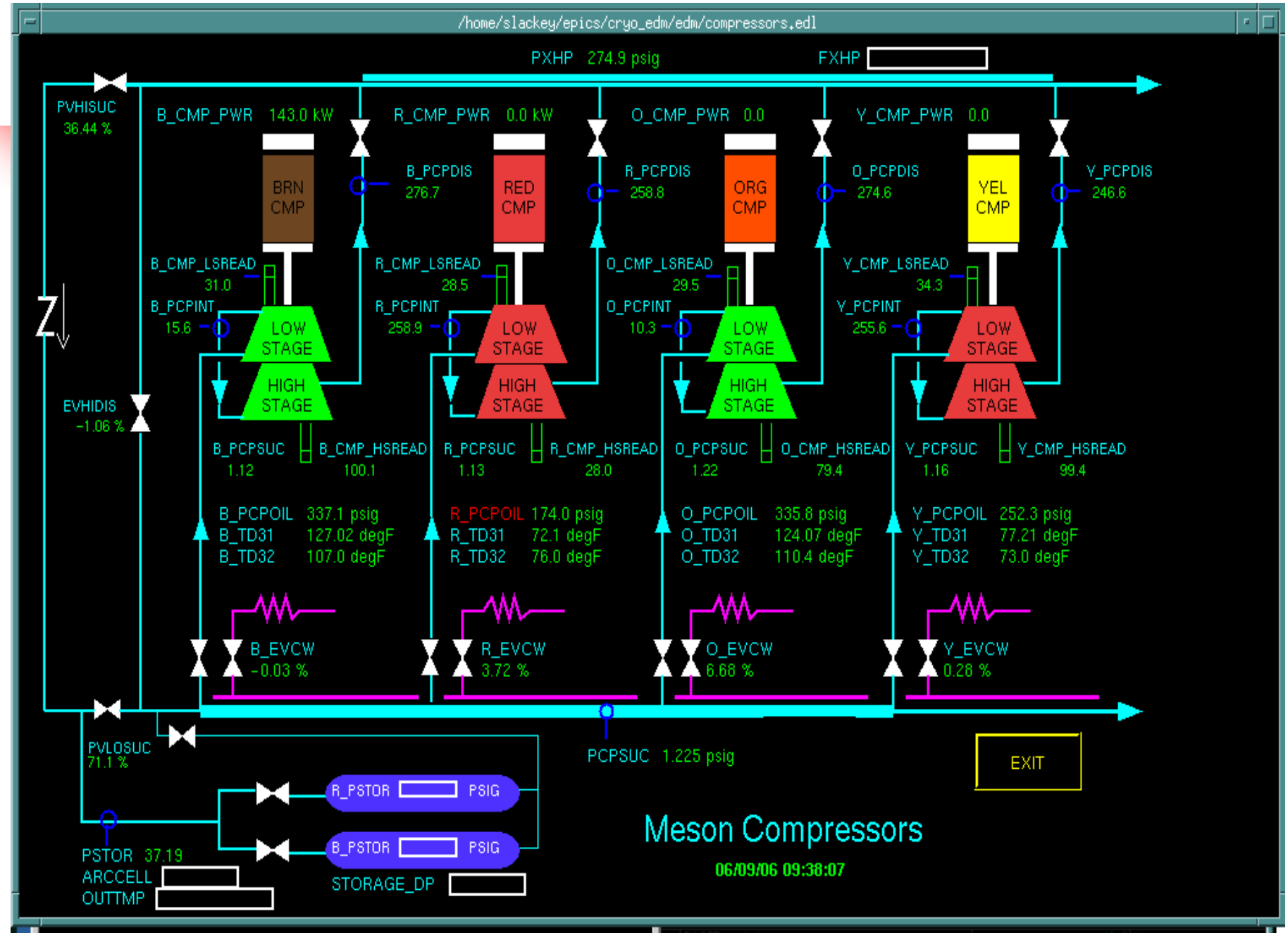
Vladimir Sirotenko and Sharon Lackey

EPICS-OPC device support from BESSY



- Base EDM page for ILCTA cryo systems
- Looks like existing ACNET GUI
- Sharon Lackey

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FXHP
PVHISUC
36.44 %
B_CMP_PWR 143.0 kW
R_CMP_PWR 0.0 kW
O_CMP_PWR 0.0
Y_CMP_PWR 0.0
BRN CMP
RED CMP
ORG CMP
YEL CMP
B_PCPDIS
276.7
R_PCPDIS
258.8
O_PCPDIS
274.6
Y_PCPDIS
246.6
B_CMP_LSREAD
31.0
R_CMP_LSREAD
28.5
O_CMP_LSREAD
29.5
Y_CMP_LSREAD
34.3
B_PCPINT
15.6
R_PCPINT
258.9
O_PCPINT
10.3
Y_PCPINT
255.6
LOW STAGE
HIGH STAGE
EVHIDIS
-1.06 %
B_PCPSUC
1.12
B_CMP_HSREAD
100.1
R_PCPSUC
1.13
R_CMP_HSREAD
28.0
O_PCPSUC
1.22
O_CMP_HSREAD
79.4
Y_PCPSUC
1.16
Y_CMP_HSREAD
99.4
B_PCPOIL 337.1 psig
B_TD31 127.02 degF
B_TD32 107.0 degF
R_PCPOIL 174.0 psig
R_TD31 72.1 degF
R_TD32 76.0 degF
O_PCPOIL 335.8 psig
O_TD31 124.07 degF
O_TD32 110.4 degF
Y_PCPOIL 252.3 psig
Y_TD31 77.21 degF
Y_TD32 73.0 degF
B_EVCW
-0.03 %
R_EVCW
3.72 %
O_EVCW
6.68 %
Y_EVCW
0.28 %
PVLOSUC
71.1 %
PCPSUC 1.225 psig
EXIT
R_PSTOR PSIG
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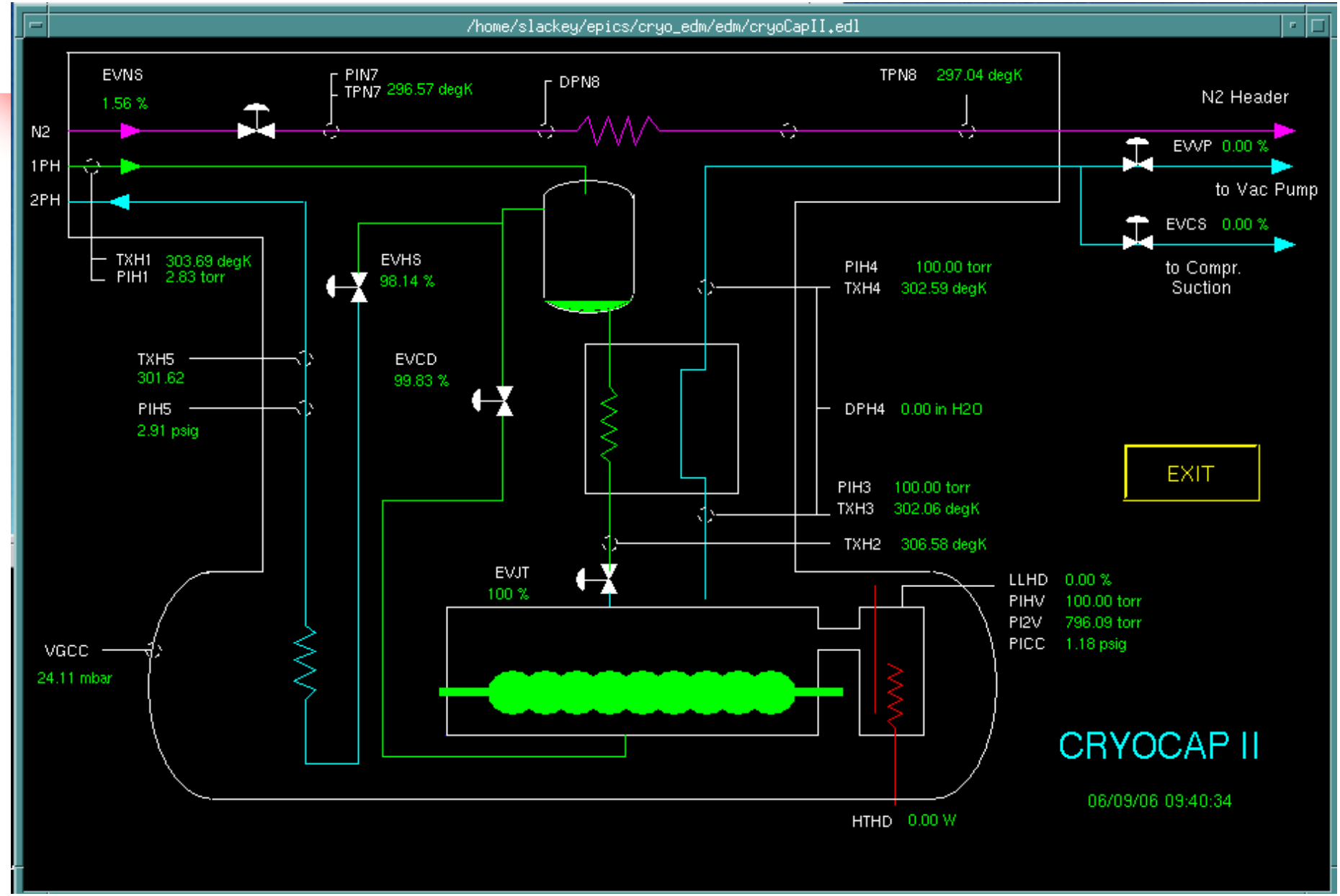
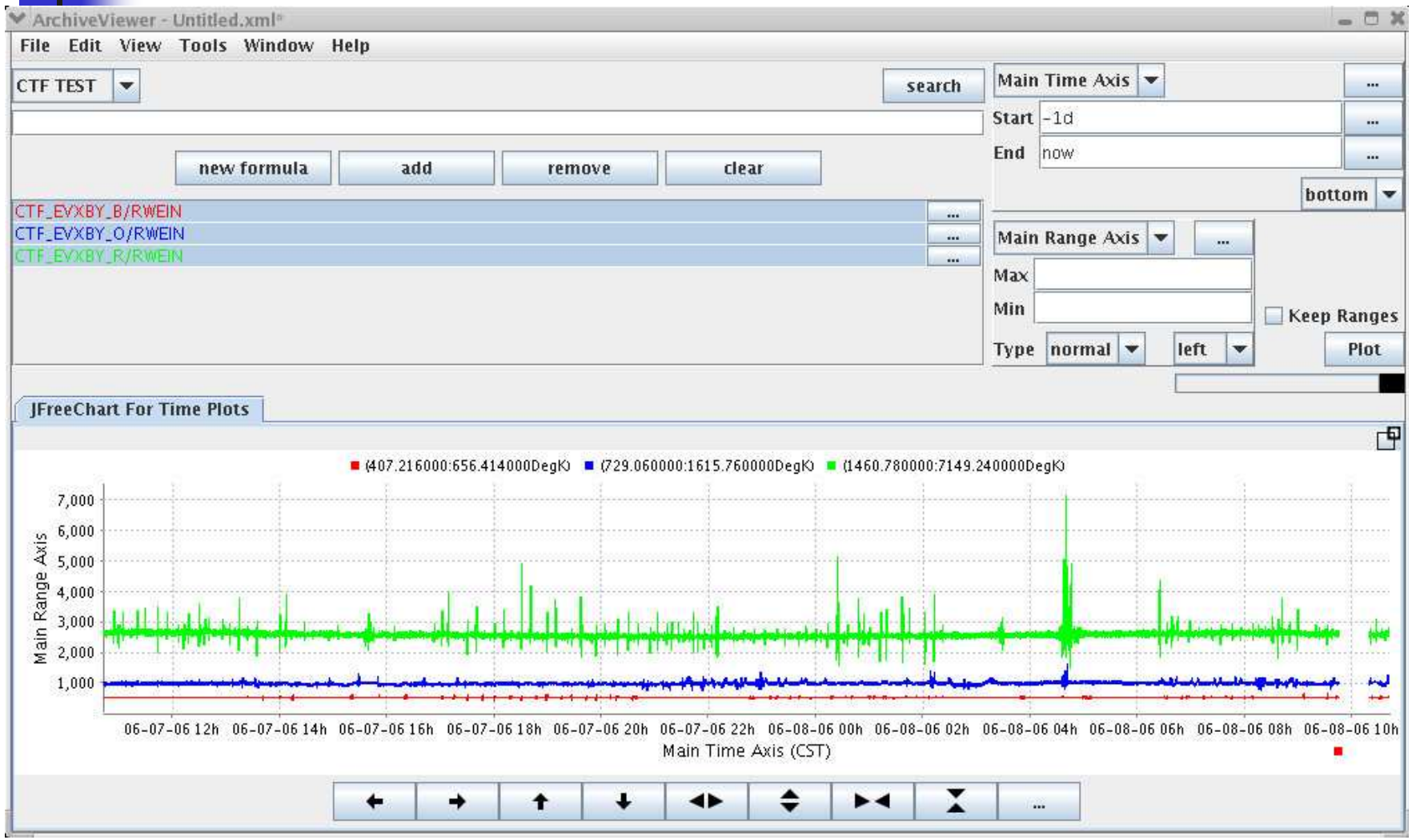
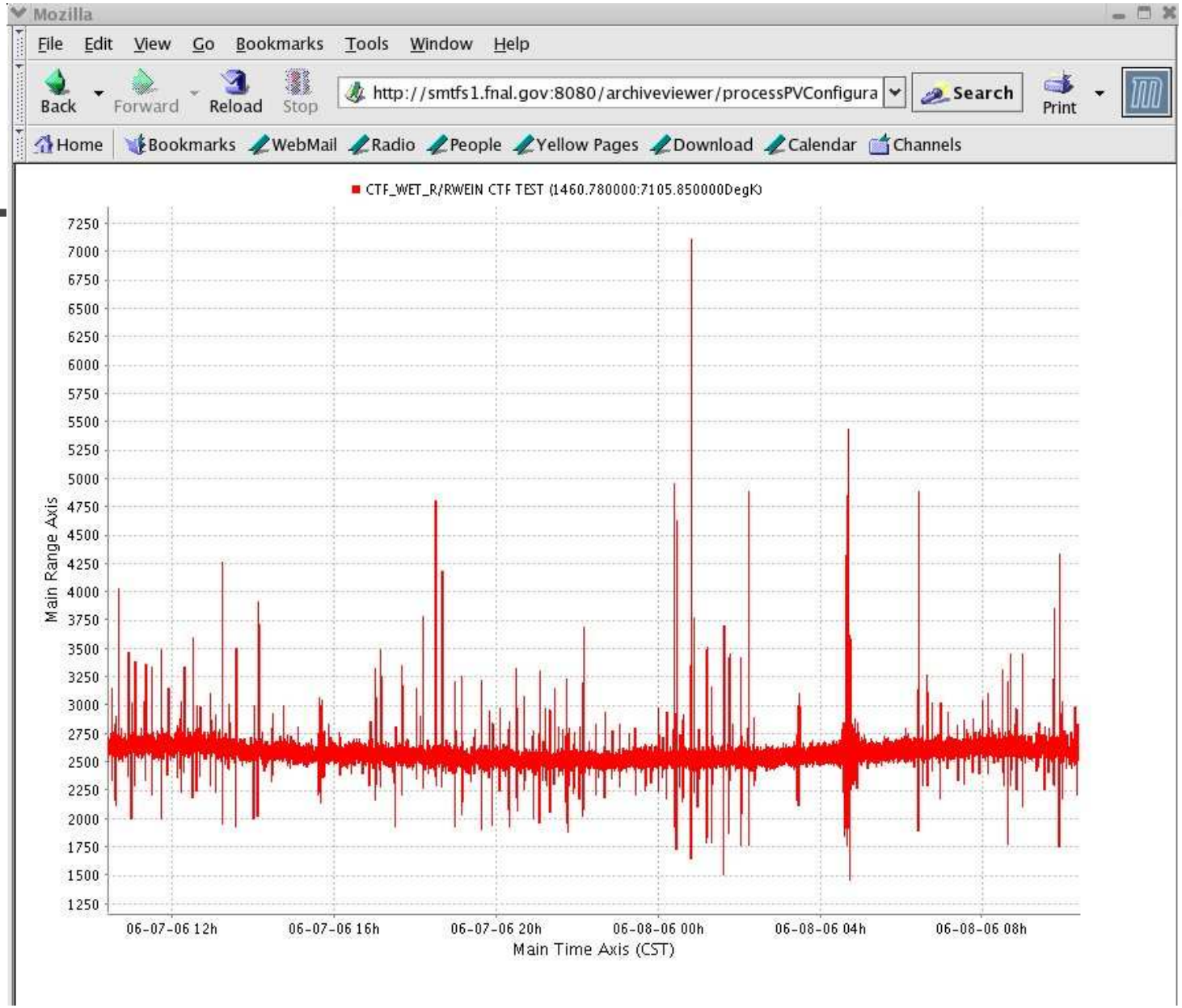

/home/slackey/epics/cryo_edm/edm/cryoCapII.edl
EVNS
1.56 %
PIN7
TPN7 296.57 degK
DPN8
TPN8 297.04 degK
N2 Header
N2
1PH
2PH
EVVP 0.00 %
to Vac Pump
EVCS 0.00 %
to Compr. Suction
TXH1 303.69 degK
PIH1 2.83 torr
EVHS
98.14 %
PIH4 100.00 torr
TXH4 302.59 degK
TXH5
301.62
PIH5
2.91 psig
EVCD
99.83 %
DPH4 0.00 in H2O
EXIT
PIH3 100.00 torr
TXH3 302.06 degK
TXH2 306.58 degK
EVJT
100 %
LLHD 0.00 %
PIHV 100.00 torr
PI2V 796.09 torr
PICC 1.18 psig
VGCC
24.11 mbar
CRYOCAP II
06/09/06 09:40:34
HTHD 0.00 W

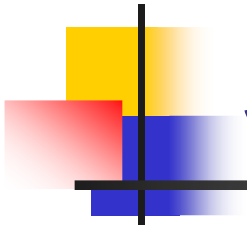
- Java parameter page
- ACNET and CA communication

Channel Archiver

Vladimir Sirotenko

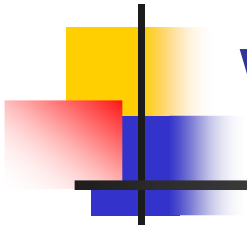



Mozilla
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://smtfs1.fnal.gov:8080/archiveviewer/processPVConfigura
Search
Print
Home Bookmarks WebMail Radio People Yellow Pages Download Calendar Channels
CTF_WET_R/RWEIN CTF TEST (1460.780000:7105.850000DegK)
Main Range Axis
7250
7000
6750
6500
6250
6000
5750
5500
5250
5000
4750
4500
4250
4000
3750
3500
3250
3000
2750
2500
2250
2000
1750
1500
1250
06-07-06 12h
06-07-06 16h
06-07-06 20h
06-08-06 00h
06-08-06 04h
06-08-06 08h
Main Time Axis (CST)



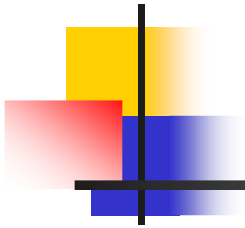
Some comments

- From Margaret Votava
  - ILCTA controls leader
  - Also working on ILC costing
- Presented to MICE (Muon Cooling) collaboration
- No modifications on my part



What is DOOCS

- Distributed Object Oriented Control System
  http://tesla.desy.de/doocs/doocs.html
- Written by a small team at DESY over the last decade
- Control system for TTF and most likely choice for XFEL
  - Cyro system is EPICS
- Features
  - Newer than EPICS and therefore makes more modern architecture choices
    - Uses RPC for communication path
    - Devices are objects
  - Includes DAQ support
  - Includes a finite state machine
  - Can talk to EPICS iocs
- Drawbacks
  - Only user group is DESY, other than then ILCTA
    - Support from experts is limited – not nearly as responsive as the EPICS community
  - Not well packaged for development outside of DESY
    - Much work done here and is getting better
  - EPICS can't talk to DOOCS devices (but this is a problem with EPICS …)

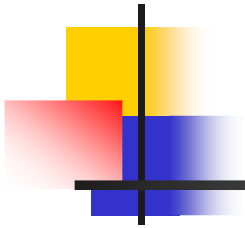


EPICS Development Issues

- Development is done by a collaboration of users:
  - ANL (primarily) supports EPICS base (ie, front end support)
  - Extensions (applications) are provided as needed – alarming, GUI support, archiving, etc
- No standards for package, quality control, support, etc for extensions
- Multiple extensions with same functionality
  - GUI support is primary example
- Larger scale developments/enhancements have no resources
  - Have a large todo list, but no organized/funded/supported todo-ers
  - ANL is committed to APS support
- Several items on todo list are to implement features already available in DOOCS

ILC Controls Digression

- Currently imagined (at least costed) as taking existing controls system as base with significant modificiation.
  - EPICS and DOOCS are obvious candidates
  - Way too early to make this decision
  - Still may decide to write from scratch
- Global controls group (excluding LLRF) consists primarily of people from ANL, FNAL, SLAC, and a little from DESY
  - add KEK and more DESY for LLRF
  - ANL and SLAC are providing personnel help for ILCTA
  - DESY providing equipment for ILCTA



ILC Tests Areas

- IB1
  - Will be EPICS, but using the DESY LLRF board
  - Cryo either IFIX or EPICS
  - Mostly TD Personnel
- MDB
  - Will most likely be all EPICS
  - Cryo is EPICS
  - Geoff working on EPICS PLC klystron interlock driver.
  - Still using old HRMs speaking classic protocol (no EPICS interface, but a DOOCS one)
  - Mostly same software personnel as proton driver (i.e., epics)
- NML – Under design/construction
  - Will take photoinjector from A0 => photoinjector control will be DOOCS for at least the short term (next year or two)
  - Cryo will be EPICS (modelled after MDB)
  - Evaluating possibility of an EPICS -> DOOCS interface so applications can be either one.
  - It's an R&D playground in addition to a facility to test cryostat